

WHAT IS CLAIMED IS:

1. A transceiver for inducing electric fields according to data to be transmitted in an electric field propagating medium, and carrying out at least data transmission by using induced electric fields, comprising:

5 a transmission unit configured to modulate the data to be transmitted by generating alternating current signals having a prescribed frequency, and transmit modulated
10 signals obtained by modulating the data to be transmitted; and

15 a resonance causing unit configured to cause a series resonance with a parasitic capacitance appearing between a ground for the transmission unit and an Earth ground and a parasitic capacitance appearing between the electric field propagating medium and the Earth Ground.

2. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric
20 fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

25 a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

30 an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

35 a control unit configured to output a control signal for controlling a characteristic of the resonance causing unit by using the electric signal converted by the electric

field detection unit and a reference signal according to the modulated signals; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

3. The transceiver of claim 2, wherein the control unit includes:

an amplifier configured to amplify the electric signal;

a differential amplifier configured to obtain a difference between the reference signal and an output signal of the amplifier, and amplify the difference;

a multiplier configured to obtain a product of an output signal of the differential amplifier and the reference signal;

a filter configured to eliminate higher harmonic components of a signal indicating the product obtained by the multiplier; and

20 an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

4. The transceiver of claim 3, further comprising:

25 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode; and

35 a second connection unit configured to connect the electric field detection unit and the amplifier at a time

of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating

5 medium.

5. The transceiver of claim 3, wherein the control unit also includes:

an additional integrator configured to generate a gain control signal for controlling a gain of the amplifier; and

10 a constant voltage source capable of applying a constant voltage to the amplifier in order to maintain the gain of the amplifier as controlled by the gain control signal generated from the additional integrator.

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6. The transceiver of claim 5, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, connect the transmission unit and the electric field detection unit without passing through the resonance causing unit at a time of adjusting the gain of the amplifier, and makes no connection at a time of carrying 20 out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

25 a second connection unit configured to connect the electric field detection unit and the control unit at a time of carrying out the data transmission and at a time of adjusting the gain of the amplifier, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating

35 medium;

a third connection unit configured to connect the transmission unit and the electric field detection unit at a time of adjusting the gain of the amplifier, and connect the transmission and reception electrode and the electric field detection unit at a time of carrying out the data transmission and at a time of carrying out the data reception; and

a fourth connection unit configured to connect the filter and the integrator while connecting the additional integrator and the constant voltage source at a time of carrying out the data transmission and at a time of carrying out the data reception, and connect the filter and the additional integrator at a time of adjusting the gain of the amplifier.

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7. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect the electric fields according to the data to be received through the transmission and reception electrode, and convert each detected electric field into an electric signal;

a control unit configured to output a control signal for controlling a frequency of the alternating current signals generated by the transmission unit by using the electric signal converted by the electric field detection

unit and a reference signal according to the modulated signals; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection

5 unit.

8. The transceiver of claim 7, wherein the control unit includes:

an amplifier configured to amplify the electric

10 signal;

a differential amplifier configured to obtain a difference between the reference signal and an output signal of the amplifier, and amplify the difference;

15 a multiplier configured to obtain a product of an output signal of the differential amplifier and the reference signal;

a filter configured to eliminate higher harmonic components of a signal indicating the product obtained by the multiplier; and

20 an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

9. The transceiver of claim 8, further comprising:

25 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode; and

30 a second connection unit configured to connect the electric field detection unit and the amplifier at a time

of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating

5 medium.

10. The transceiver of claim 8, wherein the control unit also includes:

10 an additional integrator configured to generate a gain control signal for controlling a gain of the amplifier; and

a constant voltage source capable of applying a constant voltage to the amplifier in order to maintain the gain of the amplifier as controlled by the gain control signal generated from the additional integrator.

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11. The transceiver of claim 10, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the 20 electric fields in the electric field propagating medium, connect the transmission unit and the electric field detection unit without passing through the resonance causing unit at a time of adjusting the gain of the amplifier, and makes no connection at a time of carrying 25 out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

a second connection unit configured to connect the 30 electric field detection unit and the control unit at a time of carrying out the data transmission and at a time of adjusting the gain of the amplifier, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating 35 medium;

a third connection unit configured to connect the transmission unit and the electric field detection unit at a time of adjusting the gain of the amplifier, and connect the transmission and reception electrode and the electric field detection unit at a time of carrying out the data transmission and at a time of carrying out the data reception; and

5 a fourth connection unit configured to connect the filter and the integrator while connecting the additional 10 integrator and the constant voltage source at a time of carrying out the data transmission and at a time of carrying out the data reception, and connect the filter and the additional integrator at a time of adjusting the gain of the amplifier.

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12. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further 20 comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received;

25 a transformer connected in series with the transmission unit and the transmission and reception electrode, the resonance causing unit being connected in parallel to the transformer;

30 an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

35 a control unit configured to output a control signal for controlling a characteristic of the resonance causing unit by using the electric signal converted by the electric

field detection unit and a reference signal according to the modulated signals; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

13. The transceiver of claim 12, wherein the control unit includes:

a multiplier configured to obtain a product of the reference signal and the electric signal;

a filter configured to eliminate higher harmonic components of a signal indicating the product obtained by the multiplier; and

an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

14. The transceiver of claim 13, further comprising:

a first connection unit configured to connect the transmission unit and the transformer at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the transformer at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

a second connection unit configured to connect the electric field detection unit and the multiplier at a time of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium; and

35 a third connection unit configured to connect the

resonance causing unit and the electric field detection unit at a time of carrying out the data transmission, and connect the transmission and reception electrode and the electric field detection unit at a time of carrying out the

5 data reception by receiving the electric fields induced in the electric field propagating medium.

15. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric
10 fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

15 a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received;

20 a transformer connected in series with the transmission unit and the transmission and reception electrode, the resonance causing unit being connected in parallel to the transformer;

an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

25 a control unit configured to output a control signal for controlling a frequency of the alternating current signals generated by the transmission unit by using the electric signal converted by the electric field detection unit and a reference signal according to the modulated signals; and

30 a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

35 16. The transceiver of claim 15, wherein the control unit

includes:

a multiplier configured to obtain a product of the reference signal and the electric signal;

5 components of a signal indicating the product obtained by the multiplier; and

an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

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17. The transceiver of claim 16, further comprising:

a first connection unit configured to connect the transmission unit and the transformer at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the transformer at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

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a second connection unit configured to connect the electric field detection unit and the multiplier at a time of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium; and

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a third connection unit configured to connect the resonance causing unit and the electric field detection unit at a time of carrying out the data transmission, and connect the transmission and reception electrode and the electric field detection unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium.

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18. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further

5 comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being

10 connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into

15 an electric signal;

a phase adjustment unit configured to adjust a phase of one of the electric signal converted by the electric field detection unit and a reference signal according to the modulated signals, to coincide with a phase of another

20 one of the electric signal and the reference signal;

a control unit configured to output a control signal for controlling a characteristic of the resonace causing unit by using the electric signal and the reference signal whose phases are made to coincide by the phase adjustment

25 unit; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

30 19. The transceiver of claim 18, wherein the phase adjustment unit includes:

a phase comparator configured to generate an adjustment signal for adjusting a phase difference when the phase difference exists between the electric signal and

35 the reference signal as a result of comparing phases of the

electric signal converted by the electric field detection unit and the reference signal according to the modulated signals; and

5 a phase shifter configured to receive the adjustment signal generated by the phase comparator, and adjust a phase of one of the electric signal and the reference signal.

20. The transceiver of claim 18, wherein the control unit
10 includes:

an amplifier configured to amplify the electric signal;

15 a differential amplifier configured to obtain a difference between the reference signal and an output signal of the amplifier, and amplify the difference;

a multiplier configured to obtain a product of an output signal of the differential amplifier and the reference signal;

20 a filter configured to eliminate higher harmonic components of a signal indicating the product obtained by the multiplier; and

an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

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21. The transceiver of claim 18, further comprising:

30 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the
35 transmission and reception electrode; and

a second connection unit configured to connect the electric field detection unit and the phase adjustment unit or the control unit at a time of carrying out the data transmission, and connect the electric field detection unit 5 and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium.

22. The transceiver of claim 1, wherein the transceiver 10 also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

a transmission and reception electrode configured to 15 induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

20 an electric field detection unit configured to detect the electric fields according to the data to be received through the transmission and reception electrode, and convert each detected electric field into an electric signal;

25 a phase adjustment unit configured to adjust a phase of one of the electric signal converted by the electric field detection unit and a reference signal according to the modulated signals, to coincide with a phase of another one of the electric signal and the reference signal;

30 a control unit configured to output a control signal for controlling a frequency of the alternating current signals generated by the transmission unit by using the electric signal and the reference signal whose phases are made to coincide by the phase adjustment unit; and

35 a demodulation unit configured to demodulate the

electric signal converted by the electric field detection unit.

23. The transceiver of claim 22, wherein the phase
5 adjustment unit includes:

a phase comparator configured to generate an adjustment signal for adjusting a phase difference when the phase difference exists between the electric signal and the reference signal as a result of comparing phases of the
10 electric signal converted by the electric field detection unit and the reference signal according to the modulated signals; and

a phase shifter configured to receive the adjustment signal generated by the phase comparator, and adjust a
15 phase of one of the electric signal and the reference signal.

24. The transceiver of claim 22, wherein the control unit includes:

20 an amplifier configured to amplify the electric signal;

a differential amplifier configured to obtain a difference between the reference signal and an output signal of the amplifier, and amplify the difference;

25 a multiplier configured to obtain a product of an output signal of the differential amplifier and the reference signal;

a filter configured to eliminate higher harmonic components of a signal indicating the product obtained by
30 the multiplier; and

an integrator configured to generate the control signal according to a result of integrating an output signal from the filter.

35 25. The transceiver of claim 22, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium,

5 and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode; and

10 a second connection unit configured to connect the electric field detection unit and the phase adjustment unit or the control unit at a time of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the 15 data reception by receiving the electric fields induced in the electric field propagating medium.

26. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric

20 fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

30 an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

35 a control unit configured to generate a reference signal having a constant amplitude, and output a control signal for controlling a characteristic of the resonance

causing unit by using the reference signal and the electric signal converted by the electric field detection unit; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection

5 unit.

27. The transceiver of claim 26, wherein the control unit includes:

an envelope detector configured to detect an amplitude
10 of the electric signal converted by the electric field detection unit;

a filter configured to eliminate higher harmonic components of an output signal of the envelope detector;

a constant voltage source configured to generate the
15 reference signal;

a differential amplifier configured to obtain a difference between the reference signal generated by the constant voltage source and an output signal of the filter, and amplify the difference; and

20 an integrator configured to generate the control signal according to a result of integrating an output signal from the differential amplifier.

28. The transceiver of claim 27, further comprising:

25 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode; and

30 a second connection unit configured to connect the electric field detection unit and the control unit at a

time of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating

5 medium.

29. The transceiver of claim 27, wherein the control unit also includes:

10 an additional integrator configured to generate another control signal for adjusting the reference signal.

30. The transceiver of claim 29, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time 15 of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, connect the transmission unit and the electric field detection unit without passing through the resonance causing unit at a time of adjusting the reference signal, 20 and makes no connection at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

25 a second connection unit configured to connect the electric field detection unit and the control unit at a time of carrying out the data transmission and at a time of adjusting the reference signal, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric 30 fields induced in the electric field propagating medium;

a third connection unit configured to connect the transmission unit and the electric field detection unit at a time of adjusting the reference signal, and connect the transmission and reception electrode and the electric field 35 detection unit at a time of carrying out the data

transmission and at a time of carrying out the data reception; and

a fourth connection unit configured to connect the differential amplifier and the integrator while connecting
5 the constant voltage source and the additional integrator at a time of carrying out the data transmission and at a time of carrying out the data reception, and connect the differential amplifier and the additional integrator at a time of adjusting the reference signal.

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31. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further
15 comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being
20 connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect the electric fields according to the data to be received through the transmission and reception
25 electrode, and convert each detected electric field into an electric signal;

a control unit configured to generate a reference signal having a constant amplitude, and output a control signal for controlling a frequency of the alternating
30 current signals generated by the transmission unit by using the reference signal and the electric signal converted by the electric field detection unit; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection
35 unit.

32. The transceiver of claim 31, wherein the control unit includes:

- an envelope detector configured to detect an amplitude 5 of the electric signal converted by the electric field detection unit;
- a filter configured to eliminate higher harmonic components of an output signal of the envelope detector;
- a constant voltage source configured to generate the 10 reference signal;
- a differential amplifier configured to obtain a difference between the reference signal generated by the constant voltage source and an output signal of the filter, and amplify the difference; and
- 15 an integrator configured to generate the control signal according to a result of integrating an output signal from the differential amplifier.

33. The transceiver of claim 32, further comprising:

- 20 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode; and
- 25 a second connection unit configured to connect the electric field detection unit and the control unit at a time of carrying out the data transmission, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium.

34. The transceiver of claim 32, wherein the control unit also includes:

an additional integrator configured to generate
5 another control signal for adjusting the reference signal.

35. The transceiver of claim 34, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time 10 of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, connect the transmission unit and the electric field detection unit without passing through the resonance causing unit at a time of adjusting the reference signal, 15 and makes no connection at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the transmission and reception electrode;

a second connection unit configured to connect the 20 electric field detection unit and the control unit at a time of carrying out the data transmission and at a time of adjusting the reference signal, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric 25 fields induced in the electric field propagating medium;

a third connection unit configured to connect the transmission unit and the electric field detection unit at a time of adjusting the reference signal, and connect the transmission and reception electrode and the electric field 30 detection unit at a time of carrying out the data transmission and at a time of carrying out the data reception; and

a fourth connection unit configured to connect the differential amplifier and the integrator while connecting 35 the constant voltage source and the additional integrator

at a time of carrying out the data transmission and at a time of carrying out the data reception, and connect the differential amplifier and the additional integrator at a time of adjusting the reference signal.

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36. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further 10 comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being 15 connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into 20 an electric signal;

an adjustment signal generation unit configured to output an adjustment signal for periodically changing an amplitude of the electric signal outputted from the electric field detection unit;

25 an amplitude detection unit configured to detect the amplitude of the electric signal outputted from the electric field detection unit by using the adjustment signal outputted from the adjustment signal generation unit;

30 a control signal generation unit configured to generate a control signal for controlling a characteristic of the resonance causing unit according to the amplitude detected by the amplitude detection unit; and

35 a demodulation unit configured to demodulate the electric signal converted by the electric field detection

unit.

37. The transceiver of claim 36, wherein the amplitude detection unit includes:

5 first and second envelope detectors configured to alternately detect the electric signal at a prescribed time interval;

first and second filters configured to eliminate higher harmonic components of signals outputted from the

10 first and second envelope detectors, respectively;

a differential amplifier configured to obtain a difference between output signals from the first and second filters, and amplify the difference; and

15 a constant voltage source configured to generate a constant voltage signal.

38. The transceiver of claim 37, wherein the control signal generation unit includes:

an integrator configured to generate a signal by 20 integrating an output signal from the differential amplifier; and

an adder configured to add the signal generated by the integrator and the adjustment signal outputted from the adjustment signal generation unit.

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39. The transceiver of claim 38, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of controlling the characteristic of the resonance causing 30 unit and at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the 35 electric fields induced in the electric field propagating

medium through the transmission and reception electrode;

a second connection unit configured to connect the electric field detection unit and the amplitude detection unit at a time of controlling the characteristic of the

5 resonance causing unit and at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric

10 fields induced in the electric field propagating medium;

a third connection unit configured to connect one of the first and second envelope detectors and the electric field detection unit alternately at a time of controlling the characteristic of the resonance causing unit; and

15 a fourth connection unit configured to connect the differential amplifier and the integrator at a time of controlling the characteristic of the resonance causing unit, and connect the constant voltage source and the integrator at a time of carrying out the data transmission

20 by inducing the electric fields in the electric field propagating medium.

40. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric

25 fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect

35 the electric fields according to the data to

be received, and convert each detected electric field into an electric signal;

an adjustment signal generation unit configured to output an adjustment signal for periodically changing an

5 amplitude of the electric signal outputted from the electric field detection unit;

an amplitude detection unit configured to detect the amplitude of the electric signal outputted from the electric field detection unit by using the adjustment

10 signal outputted from the adjustment signal generation unit;

a control signal generation unit configured to generate a control signal for controlling a frequency of the alternating current signals generated by the

15 transmission unit according to the amplitude detected by the amplitude detection unit; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

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41. The transceiver of claim 40, wherein the amplitude detection unit includes:

first and second envelope detectors configured to alternately detect the electric signal at a prescribed time

25 interval;

first and second filters configured to eliminate higher harmonic components of signals outputted from the first and second envelope detectors, respectively;

30 a differential amplifier configured to obtain a different between output signals from the first and second filters, and amplify the difference; and

a constant voltage source configured to generate a constant voltage signal.

35 42. The transceiver of claim 41, wherein the control

signal generation unit includes:

an integrator configured to generate a signal by integrating an output signal from the differential amplifier; and

5 an adder configured to add the signal generated by the integrator and the adjustment signal outputted from the adjustment signal generation unit.

43. The transceiver of claim 42, further comprising:

10 a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of controlling the frequency of the alternating current signals generated by the transmission unit and at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and
15 disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium through the
20 transmission and reception electrode;

a second connection unit configured to connect the electric field detection unit and the amplitude detection unit at a time of controlling the frequency of the alternating current signals generated by the transmission unit and at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric fields induced in the electric field propagating medium;
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a third connection unit configured to connect one of the first and second envelope detectors and the electric field detection unit alternately at a time of controlling the frequency of the alternating current signals generated by the transmission unit; and
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a fourth connection unit configured to connect the differential amplifier and the integrator at a time of controlling the frequency of the alternating current signals generated by the transmission unit, and connect the
5 constant voltage source and the integrator at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium.

44. The transceiver of claim 1, wherein the transceiver
10 also carries out data reception by receiving electric fields according to data to be received which are induced in the electric field propagating medium, and further comprises:

15 a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

20 an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

25 an amplitude detection unit configured to detect the amplitude of the electric signal outputted from the electric field detection unit;

30 a memory unit configured to store the amplitude detected by the amplitude detection unit in relation to a characteristic of the resonance causing unit;

a maximum value related information extraction unit configured to extract the characteristic set in relation to a maximum value of the amplitude stored in the memory unit;

35 a control signal generation unit configured to generate a control signal for controlling the resonance causing unit to maintain the characteristic extracted by

the maximum value related information extraction unit; and
a demodulation unit configured to demodulate the
electric signal converted by the electric field detection
unit.

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45. The transceiver of claim 44, wherein the maximum value
related information extraction unit includes:

an analog/digital conversion unit configured to
convert the amplitude outputted from the amplitude

10 detection unit into a digital signal; and

a control information sending unit configured to store
the digital signal related to the amplitude converted by
the analog/digital conversion unit into the memory unit,
reads out the characteristic set in relation to the maximum
15 value of the amplitude stored in the memory unit, and send
a control information necessary in carrying a control
according to a read out characteristic to the control
signal generation unit.

20 46. The transceiver of claim 44, further comprising:

a first connection unit configured to connect the
transmission unit and the resonance causing unit at a time
of controlling the characteristic of the resonance causing
unit and at a time of carrying out the data transmission by
25 inducing the electric fields in the electric field
propagating medium, and disconnect a connection between the
transmission unit and the resonance causing unit at a time
of carrying out the data reception by receiving the
electric fields induced in the electric field propagating
30 medium through the transmission and reception electrode;
and

a second connection unit configured to connect the
electric field detection unit and the amplitude detection
unit at a time of controlling the characteristic of the
35 resonance causing unit and at a time of carrying out the

data transmission by inducing the electric fields in the electric field propagating medium, and connect the electric field detection unit and the demodulation unit at a time of carrying out the data reception by receiving the electric
5 fields induced in the electric field propagating medium.

47. The transceiver of claim 1, wherein the transceiver also carries out data reception by receiving electric fields according to data to be received which are induced
10 in the electric field propagating medium, and further comprises:

a transmission and reception electrode configured to induce the electric fields according to the data to be transmitted and receive the electric fields according to
15 the data to be received, the resonance causing unit being connected in series with the transmission unit and the transmission and reception electrode;

an electric field detection unit configured to detect the electric fields according to the data to be received, and convert each detected electric field into an electric signal;

an amplitude detection unit configured to detect the amplitude of the electric signal outputted from the electric field detection unit;

25 a memory unit configured to store the amplitude detected by the amplitude detection unit in relation to a frequency of the alternating current signals generated by the transmission unit;

30 a maximum value related information extraction unit configured to extract the frequency set in relation to a maximum value of the amplitude stored in the memory unit;

35 a control signal generation unit configured to generate a control signal for controlling the transmission unit to generate the alternating current signals with the frequency extracted by the maximum value related

information extraction unit; and

a demodulation unit configured to demodulate the electric signal converted by the electric field detection unit.

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48. The transceiver of claim 47, wherein the maximum value related information extraction unit includes:

an analog/digital conversion unit configured to convert the amplitude outputted from the amplitude

10 detection unit into a digital signal; and

a control information sending unit configured to store the digital signal related to the amplitude converted by the analog/digital conversion unit into the memory unit, reads out the frequency set in relation to the maximum 15 value of the amplitude stored in the memory unit, and send a control information necessary in carrying a control according to a read out frequency to the control signal generation unit.

20 49. The transceiver of claim 47, further comprising:

a first connection unit configured to connect the transmission unit and the resonance causing unit at a time of controlling the frequency of the alternating current signals generated by the transmission unit and at a time of 25 carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and disconnect a connection between the transmission unit and the resonance causing unit at a time of carrying out the data reception by receiving the electric fields induced in 30 the electric field propagating medium through the transmission and reception electrode; and

a second connection unit configured to connect the electric field detection unit and the amplitude detection unit at a time of controlling the frequency of the 35 alternating current signals generated by the transmission

unit and at a time of carrying out the data transmission by inducing the electric fields in the electric field propagating medium, and connect the electric field detection unit and the demodulation unit at a time of
5 carrying out the data reception by receiving the electric fields induced in the electric field propagating medium.

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